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# WESTERN UTILIZATION RESEARCH & DEVELOPMENT DIVISION

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Albany, California  
January, 1961  
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# ORGANIZATION

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## UNITED STATES DEPARTMENT OF AGRICULTURE AGRICULTURAL RESEARCH SERVICE

Washington 25, D. C.

BYRON T. SHAW  
*Administrator*

GEORGE W. IRVING, JR.  
*Deputy Administrator, Utilization Research & Development*

## WESTERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION

Albany, California

M. J. COPLEY  
*Director*

W. B. VAN ARSDEL  
*Assistant Director*

C. H. H. NEUFELD  
*Assistant Director*

I. J. GIRGICH  
*Assistant to Director for Management*

FRED STITT  
*Assistant Director*

W. F. TALBURT  
*Assistant Director*

P. L. BLAKE  
*Mechanical Superintendent*

### RESEARCH LABORATORIES

Field Crops Laboratory  
G. O. KOHLER, *Chief*

Fruit Laboratory  
W. L. STANLEY, *Acting Chief*

Vegetable Laboratory  
H. K. BURR, *Acting Chief*

Engineering & Development Laboratory  
W. D. RAMAGE, *Chief*

Wool & Mohair Laboratory  
H. P. LUNDGREN, *Chief*

Subtropical Fruit Laboratory  
E. A. BEAVENS, *Chief*

Poultry Laboratory  
HANS LINEWEAVER, *Chief*

Pharmacology Laboratory  
FLOYD DEEDS, *Chief*

Plant Enzyme Pioneering Laboratory  
E. F. JANSEN, *Chief Chemist*

### FIELD STATIONS

Fruit & Vegetable Chemistry Laboratory  
Pasadena, California  
E. A. BEAVENS, *In Charge*

Fruit & Vegetable Products Laboratories  
Prosser & Puyallup, Washington  
A. M. NEUBERT, *In Charge*

## ORIGIN AND PROGRAM

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**A**gricultural utilization research is an organized effort through science and technology to increase present uses and to discover and develop new uses for farm products. Farmers need new markets and strengthened demand for their output -- this is particularly true for commodities now in surplus -- and the Nation needs the new and better products that science can create from agricultural materials.

Utilization research was conducted in small isolated laboratories until passage of the Agricultural Adjustment Act of 1938, which provided for construction of a centralized laboratory in each of the four major crop-producing areas of the United States. These are the Eastern Utilization Research and Development Division in Wyndmoor, Pennsylvania; the Northern in Peoria, Illinois; the Southern in New Orleans, Louisiana; and the Western in Albany, California.

In the Western Division, emphasis is on wool and mohair, wheat, barley, rice, forage crops, fruits and vegetables, poultry and eggs, tree nuts, dry beans and peas, castor seed, sugar beets, and various new crops. These commodities are important to the

area primarily served by the Western Division -- Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Research of mutual interest is conducted in collaboration with State Agricultural Experiment Stations. Close contact is maintained through frequent meetings and conferences.

Advisory committees, established under the Research and Marketing Act of 1946, assist the Department of Agriculture in the selection and guidance of its research programs. Members are appointed by the Secretary of Agriculture to represent all major interests -- farmers, processors, transportation and storage groups, distributors, and ultimate consumers.

To expand and supplement the scope of its research program, the Department contracts with qualified persons or organizations to perform specified research, particularly in areas that require personnel or facilities not available within the Department.

A foreign utilization research program was initiated in 1958. It is financed with foreign currencies accruing to the United States from the sale of surplus agricultural commodities. The foreign program is closely correlated with research done in the Department's own laboratories, thus augmenting the total research effort.

# FACILITIES

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The Western Regional Research Laboratory, headquarters for the Western Utilization Research and Development Division, houses administrative offices, conference rooms, an extensive library of agricultural and other scientific publications, and about 150 laboratory rooms.

Special installations permit a comprehensive research attack. Laboratories equipped for radio-isotope work allow studies of enzymatic and chemical reaction mechanisms; organoleptic evaluations are made in rooms with controlled atmosphere and lighting; the baking laboratory has modern testing instruments, ovens, and forming and mixing machines; commercial types of equipment are installed for experimental fruit and vegetable processing, egg product and poultry meat technology, sugar beet processing, and chemical engineering operations. Specially designed refrigeration facilities are noteworthy. The new Wool Processing Laboratory, a separate building, contains textile equipment for experimental study of the operations of worsted cloth production.

Physical laboratory equipment available includes an ultracentrifuge; electron microscope; X-ray diffractometer and spectrometer; light-scattering and flame photometers; emission spectrograph; automatic recording infrared, ultraviolet, and visible spectrophotometers; and nuclear magnetic resonance and electron spin resonance spectrometers.

At Pasadena, California, both laboratory and experimental processing facilities are available in a building erected by the Department in 1949.



WESTERN  
REGIONAL  
RESEARCH  
LABORATORY



WOOL  
PROCESSING  
LABORATORY



FRUIT AND  
VEGETABLE  
CHEMISTRY  
LABORATORY



## FIELD CROPS LABORATORY

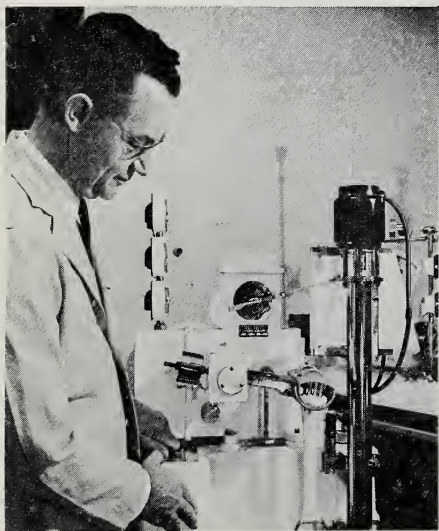
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Improved processing methods for and basic chemical composition of wheat, rice, barley, alfalfa and other forages, castor beans and other promising potential oil crops such as the *Dimorphotheca* species (Cape Marigold), and sugar beets are investigated.

Better flavored and textured bread products, pre-cooked canned and "instant" dry wheat and rice foods are among the objectives of product development work. Flavor compounds in bread are studied to improve their stability.

Improved feedstuffs from wheat, barley, and forages can result from isolation, identification, and characterization of their individual components. Process developments seek maximum stability of nutrients and elimination of growth inhibitors or other undesirable constituents.

Castor oil is studied as a raw material for plastics and both rigid and rubber-like foams. A study of the oil obtained from the seeds of *Dimorphotheca* species has been initiated in an effort to find replacement crops not competitive with established domestic crops. The unusual chemical properties of this oil indicate that it has marked potential industrial usefulness.



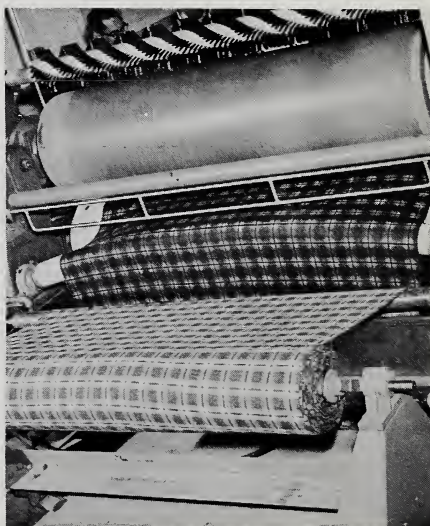
Improved sugar beet processing methods, correlations between the composition of sugar beets and juices and their sugar-processing quality, and new industrial uses for sucrose and other beet constituents are being investigated.

# WOOL AND MOHAIR LABORATORY

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**F**undamental research on the physical and chemical properties of wool and mohair fibers serves as a guide in changing fiber structure, both internally and on the surface, to produce greater resistance of fabrics to shrinkage, sunlight, heat, acids, alkalis, and bleaches.

In the new Wool Processing Laboratory commercial types of equipment are used to investigate every step of processing wool on the worsted system. The aim is to make wool more widely useful, particularly for garments that can be home-laundered and worn with little or no pressing. Methods for imparting shrink-resistance have been developed. To this property must be added resistance to wrinkling, soiling, pilling and abrading; also desired are pleats and creases permanent to washing. These properties must be attained without loss of wool's desirable qualities such as softness, warmth, and comfort.



Application of shrinkproofing resin to wool fabric.

# FRUIT LABORATORY

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**B**asic investigations of fruits and fruit products are under way to determine the constituents responsible for flavor, texture, color, and specific physiological effects, and to identify and control chemical and enzymatic reactions responsible for quality changes which occur during and after processing.

Processes for preserving fruits are improved and new products are developed by application of the knowledge developed in basic research. Processes under investigation include freezing, canning, and dehydration as well as methods which combine two or more of these, such as dehydrofreezing and dehydrocanning.

Cooperative investigations are under way with other agencies of the Agricultural Research Service, the Agricultural Marketing Service, and the Agricultural Experiment Stations of the western States, particularly at the Division's Washington field stations. Studies include the evaluation for processing quality of new varieties, determination of optimum maturity for processing, and the best methods for handling commodities to assure optimum processing quality. This research is vital to the processor in adapting his operations to changing methods of crop production and changes in raw material characteristics.

Research of certain kinds is participated in by the food industry through collaborative research programs. Close coordination of the research under way in the Laboratory and in industry prevents duplication of effort and results in more comprehensive investigations of problems facing the entire industry.

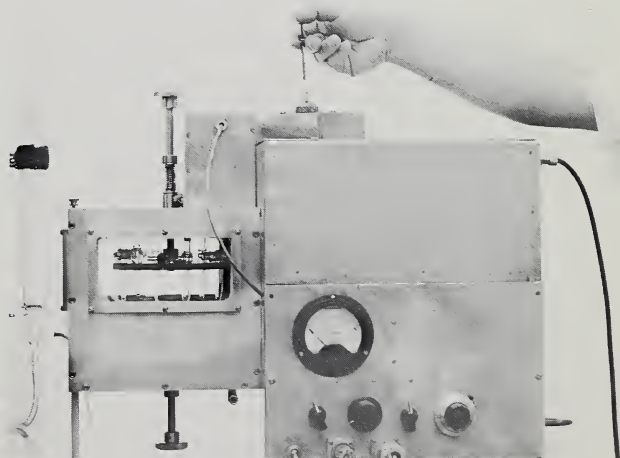


## SUBTROPICAL FRUIT LABORATORY

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**R**esearch is conducted at Pasadena, California, on citrus, dates, and other subtropical fruits of Southern California, Arizona, and Hawaii, and on tree nuts and dry beans. Close cooperation is maintained with growers and processors of these crops who support financially a substantial part of the program. Chemical and physical properties are studied to determine and control quality changes during and after processing. Current research includes studies on the chemistry of citrus oils; isolation and identification of citrus flavonoids; mechanisms which cause browning in dates; studies on the mechanism of rancidification of shelled walnuts; investigation of processes for stabilizing moisture content of fruits, nuts, and fruit pieces; and methods for removing precursors of compounds responsible for citrus off-flavors.

Gas chromatography  
can unlock the  
secrets of food  
flavor.



# VEGETABLE LABORATORY

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**R**esearch on the composition of vegetables and vegetable products is being conducted to provide the information necessary for understanding changes that occur during and after processing. The relation of composition to color, flavor, and texture is being determined as a basis for developing new and improved processed products. Enzymatic and nonenzymatic reactions associated with flavor and color changes are being investigated.

Applied research on the technology of freezing, canning, and dehydrating is assuring the continuing advance of the food processing industry. A broad program of research on preservation of vegetables and the effect of time-temperature experiences is under way, much of it in close cooperation with growers and processors who support financially certain phases of the work. Cooperative projects are also conducted with other Divisions of the Agricultural Research Service, the Agricultural Marketing Service, and the Agricultural Experiment Stations of the western States.

Microbiologists study the microflora of processed vegetables, the nature of bacterial spores, and the utility of antibiotics in food processing.

The complex problems of food appraisal are being investigated by means of trained taste panels and by objective measurement. Improved techniques for judging the acceptability of food products are being developed as a part of comprehensive investigations on the effect on quality of various processing procedures.

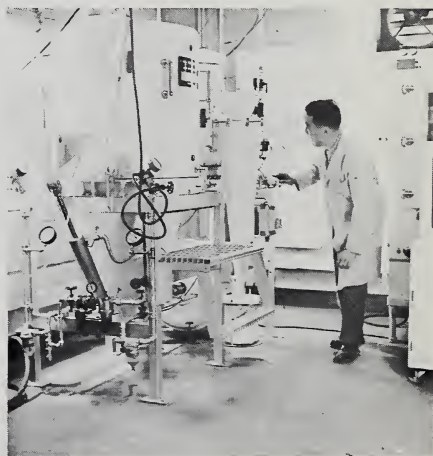
# POULTRY LABORATORY

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The critical role of flavor and tenderness in maintaining and increasing poultry consumption has prompted fundamental studies of the chemical nature of poultry flavor and the reactions affecting tenderness, as well as practical evaluations of current commercial processing variables.

Studies are conducted on characterization of egg components and on the effect of processing on their behavior. Fundamental information is applied to the development of new and improved egg products including frozen, concentrated, and dried products. Of current interest is the development of dehydrated egg products having improved stability and dispersibility. The studies require the application of advanced microbiological and organoleptic techniques as well as the techniques of chemistry and physics.

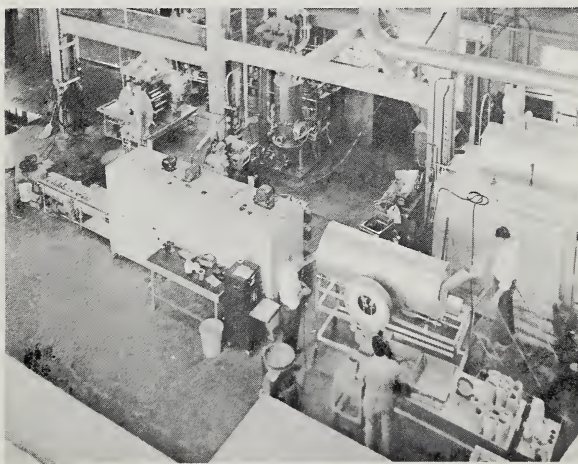
EGG PROCESSING  
LABORATORY



# ENGINEERING AND DEVELOPMENT LABORATORY

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New types of processing equipment are designed, fabricated, and tested; the economic feasibility of new processes and the market potential of new products are studied; and engineering studies required to evaluate new processes and products are conducted. Pilot-plant operations reveal optimum operating conditions, raw material requirements, and product yields. The work includes: pasteurization, sterilization, concentration, and dehydration of fluid-form products such as fruit and vegetable juices; dehydration of fruits, vegetables, and rice; and dehydrofreezing and dehydrocanning of food products. Basic research is conducted on unit operations, such as evaporation, heat transfer, and fluid flow.



Experimental processing equipment in the Pilot Plant.



# PHARMACOLOGY LABORATORY

This Laboratory carries out pharmacological investigations for the utilization research program of the Department of Agriculture. Investigations include study of physiological action of a wide variety of compounds important to agriculture. These compounds may be food additives, pesticides, new antibiotics, medicinals, or naturally occurring minor chemical constituents of foods or feeds. Chemical additives are tested to determine the safety of their use in processed foods and feeds destined for consumption by humans or animals. Similarly, the beneficial or harmful effects of naturally occurring chemicals are determined.

At present several major classes of chemicals are being examined, including: food additives important for the prevention of microbial and insect deterioration of dried fruits; toxic and allergenic substances naturally present in castor seed meal which must be identified so that they may be eliminated or inactivated; and plant constituents which have been shown to exert estrogenic or growth-promoting effects on farm animals.

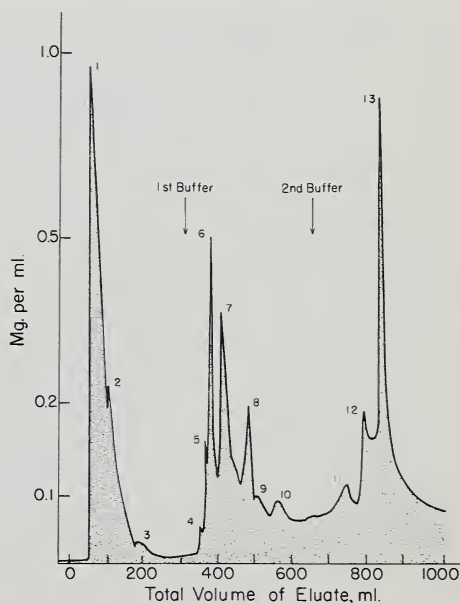


Chart representing fractionation of the soluble components of castor seed.

# PLANT ENZYME PIONEERING LABORATORY

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Creative pioneering studies, undertaken for the purpose of broadening knowledge and developing new scientific laws and principles, are conducted in a number of recently established Pioneering Research Laboratories in the Agricultural Research Service. These have been organized around outstanding scientists who have demonstrated a capacity for creative research.

Research being carried out in our Pioneering Laboratory concerns the recognition, exploration, and detailed study of enzymatic reactions in plant tissues. Most chemical reactions which occur in plant tissue are enzymatically catalyzed, e.g., the formation and alteration of nutrients, vitamins, pigments, and odor and flavor constituents. Fundamental information obtained in

these studies will be applicable to many aspects of the Department's program of research and development on new and improved plant products.



Radioisotopes trace  
enzyme reactions

# PUBLICATIONS AND PATENTS

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**T**he Western Division has produced nearly 2000 publications since its establishment in 1941. Information obtained from research is made known to industry and the public in general; various media are used, particularly scientific, technical, and trade journals. A list of current publications is issued every six months; it is available upon request.

If research and development work result in a discovery that is patentable, a patent assigned to the Secretary of Agriculture is obtained in the name of the inventor or inventors. Individuals and organizations may obtain, without cost, a license from the Department to use the patented invention. For information, write to the Director of the Division.

Over two hundred patents have been obtained since the Division was established. They pertain to a wide range of subjects among which are: food preparation and preservation, food processing equipment, preparation and use of pectin and pectin derivatives, solubilization of keratins and preparation of other protein derivatives, preparation of antibiotic substances, processing of wool, stabilization of carotene in alfalfa, processing of sugar beets, synthesis of new organic compounds, and treatment of pear waste to recover useful products.

## BASIC INVESTIGATIONS

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All problems investigated by the Division are likely to include some aspects whose solution requires research of a fundamental nature. Such research is conducted as an integral part of the program of each of the Laboratories, and it results in the extension of knowledge in many of the basic scientific disciplines. Following are some examples of current or recent investigations which have been especially productive of fundamental information.

Expanded utilization of wheat, a gigantic problem and opportunity, is being sought vigorously in many different ways. A difficulty common to most of these efforts is the fragmentary nature of our knowledge about the composition, reactions, and properties of the constituents of wheat flour, especially the proteins, and the research attack has included extensive study of this field.

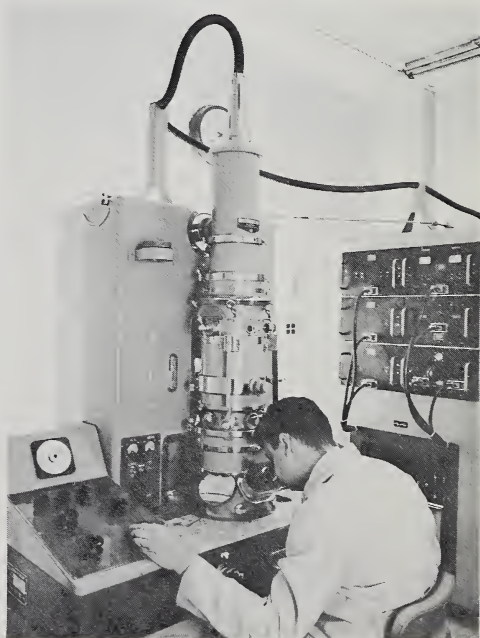
The relation between structure and chemical and physical properties of wool proteins and their derivatives is being investigated by many techniques including such recently developed methods as measurement of nuclear magnetic resonance and electron spin resonance.

The mechanisms of enzymatic changes in fruits, vegetables, and their products are being explored. Composition, reactions, and properties of isolated plant constituents, including those responsible for characteristic flavors, colors, and physiological effects, are being studied in detail.

Compounds responsible for poultry meat flavor are being separated and identified. All but a small proportion of the protein constituents of eggs have been separated and individually characterized.

In general, every field of commodity research now active in the Division encompasses some phases in which the basic approach is used.

Ultrastructure of  
plant and animal  
tissues is studied  
by electron microscopy.



# SOME RECENT ACHIEVEMENTS

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## STUDIES ON FROZEN FOODS



A comprehensive study of commercially important frozen fruits, vegetables, poultry products, and prepared foods has defined many of the fundamental chemical and other quality changes which occur in foods during processing and subsequent storage at low temperatures. Color, flavor, and other quality factors are well maintained for a year or more at 0°F., but adverse changes take

place so much faster at 15° or 20° that they become perceptible in a few weeks or days.

More than 20 technical articles about these investigations, plus exhibits, lectures, and panel discussions at national meetings, provide authoritative information for frozen food producers and distributors, educational groups, and regulatory agencies. Recognition of this work has been made by the Department's Distinguished Service Award, a citation and plaque from the National Frozen Food Distributors Association, and the Award of Merit from the National Association of Frozen Food Packers. As a result of this work, the frozen food industry is engaged in a multi-million dollar program of improvement in its equipment and procedures.



## FORAGE STABILIZATION

The value of dehydrated forage as an animal feed ingredient is partly dependent on its content of provitamin A (carotene), vitamin E, and xanthophyll. Unfortunately, when the dried forage is stored these components are lost rapidly by oxidation and other deteriorative reactions. Much of this loss can be prevented by addition of an effective antioxidant. Because no really active forage antioxidant was known, the Division's Field Crops Laboratory conducted a screening program in which over 400 chemical compounds were tested for their ability to prevent deterioration of carotene and xanthophyll. The compound selected is now commercially available as "ethoxyquin", and approval for its addition to forages and animal feeds was granted following extensive pharmacological testing.

The significance of this research is considerable. Application of 0.3 pound of antioxidant per ton of dehydrated forage results in the retention of about three-fourths of the labile nutrients over a 6-month storage period. Untreated forage retains only one-fourth of these nutrients under the same storage conditions. Because of the effectiveness and low cost of the treatment (less than \$1 per ton of forage or feed), the procedure has been widely adopted by the forage dehydration and mixed feed industries, with very substantial savings in nutrient value.

## CHEMISTRY OF CITRUS FLAVONOIDS

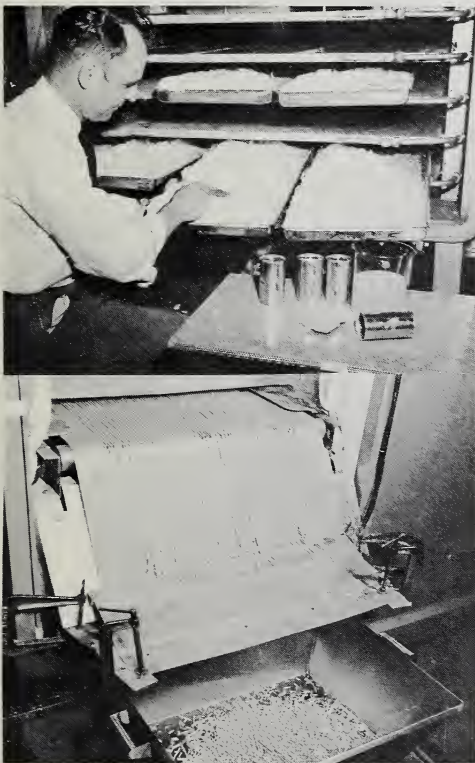
Citrus fruits contain a number of chemical substances called flavonoids. Several of these compounds impart a bitter flavor to citrus, while others may cause darkening during storage of citrus products. A number of the flavonoids are important also because of their pharmacological activity and these are produced by the citrus industry for use in drugs and other applications. The influence of these flavonoids on citrus product quality and their industrial-pharmacological potential prompted an intensive research effort to learn more about them.

The separation and identification of flavonoids is unusually difficult because they occur in citrus as complex mixtures. New procedures have been developed and flavonoids isolated in quantities sufficient to establish their identities, chemical reactivities, and pharmacological activities. Lemons have been shown to contain fifteen flavonoids and related compounds, several of which had never before been identified, and one which may be responsible for lemon juice browning. It was also discovered that the bitterness of some flavonoids is caused by the presence of a certain type of sugar attached to the flavonoid molecule. All bitter flavonoids examined contained this substance. This information now makes it possible to predict which flavonoids will be bitter and thus to devise ways of controlling bitterness in citrus products.



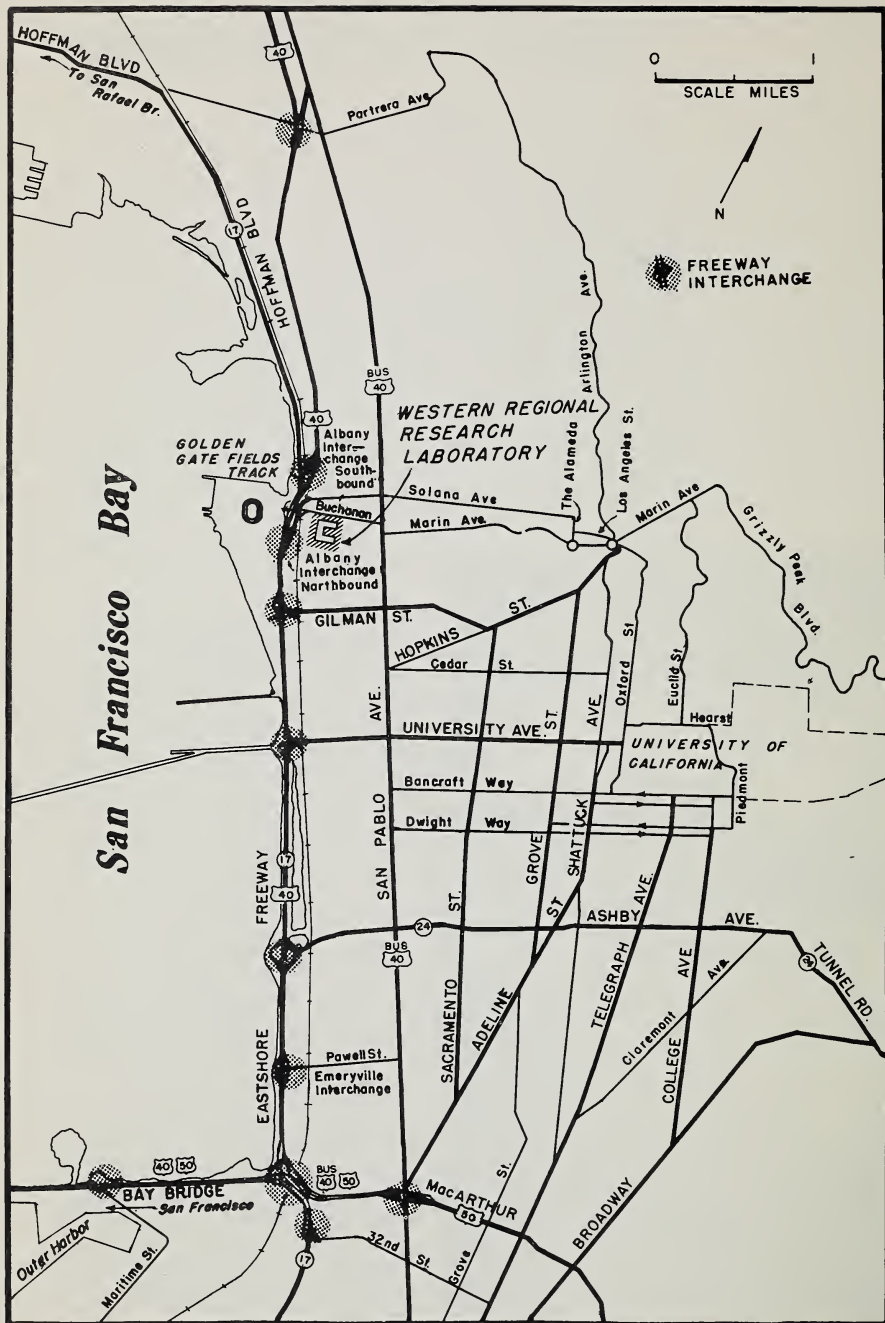
## JUICE POWDERS

**F**ruit and vegetable juice powders which dissolve almost instantly in water and give beverages comparable to fresh juices in flavor, color, and vitamin content, are prepared by vacuum drying juice concentrates under conditions that cause expansion, or puffing, of the product. These "puff-dried" powders, because of their low moisture contents, do not require refrigeration and are quite stable at temperatures as high as 90° to 100°F. Present annual production of orange and grapefruit powders exceeds one million pounds, equivalent to over a million gallons of fresh juice.



In a newer method for making fruit and vegetable powders, liquiform concentrates as stable foams are dried in a gas stream at atmospheric pressure. This method, called "foam-mat" drying, produces high-quality products. It has aroused wide-spread interest among commercial processors.

Marketing of fruit and vegetable products as powders can save many millions of dollars in storage and transportation costs.



# VISITORS WELCOME

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**V**isitors are always welcome. Groups who wish conducted tours should make arrangements in advance to assure coverage of subjects of particular interest. Conferences can be arranged with staff members. Foreign visitors are welcome; arrangements can be made through the Office of International Relations, Agricultural Research Service, Washington 25, D.C.

## WESTERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION

**Headquarters:** Western Regional Research Laboratory  
800 Buchanan Street  
Albany 10, California

**Telephone:** LAndscape 5-2244

**Hours:** 8:30 a.m. to 5 p.m., Monday through Friday.

**Location and Transportation:** Albany is across the bay from San Francisco and north of Oakland and Berkeley. The Laboratory is just off the Eastshore Freeway, U.S. Highway 40, at the Albany Interchange. Local buses are available from Oakland, Berkeley, and the San Francisco areas. From San Francisco, buses traveling to Albany leave from the Bridge Terminal, 1st and Mission Streets.

### Field Stations:

Fruit and Vegetable Chemistry Laboratory  
263 South Chester Avenue, Pasadena, California  
Telephone – SYcamore 6-0239

Fruit and Vegetable Products Laboratory\*  
Prosser, Washington. Telephone – YUkon 4-5512

Fruit and Vegetable Products Laboratory\*  
Puyallup, Washington. Telephone – THornwall 5-6612

\*In cooperation with Washington State Agricultural Experiment Stations.

# GENERAL INFORMATION ABOUT THE UTILIZATION RESEARCH AND DEVELOPMENT DIVISIONS

DIVISION	DIVISION DIRECTOR	MAILING ADDRESS	DIVISION AREA*	FIELDS OF RESEARCH
Eastern	P. A. Wells	600 E. Mermaid Lane Philadelphia 18, Pa.	Conn., Del., Ky., Maine, Md., Mass., N.H., N.J., N.Y., Pa., R.I., Vt., Va., W. Va.	Animal products: dairy, meat, fats, and leather. Plant products: Eastern fruits and vegetables, tobacco, honey, maple, and new crops. Allergen studies.
Northern	F. R. Senti	1815 N. University St. Peoria 5, Illinois	Ill., Ind., Iowa, Kans., Mich., Min., Mo., Nebr., N. Dak., Ohio, S. Dak., Wis., Alaska	Cereal grains: corn, wheat, barley, grain sorghum, and oats. Oilseeds: soybean, flaxseed, safflower, and erucic acid-containing oilseeds. New crops.
Southern	C. H. Fisher	1100 Robert E. Lee Blvd. New Orleans 19, La.	Ala., Ark., Fla., Ga., La., Miss., N. C., Okla., Puerto Rico, S. C., Tenn., Texas.	Cotton and cottonseed; tung fruit; pine gum; Southern fruits and vege- tables including citrus, sweet- potatoes, and cucumbers; sugarcane; rice; peanuts; new crops.
Western	M. J. Copley	800 Buchanan Street Albany 10, California	Ariz., Calif., Colo., Hawaii, Idaho, Mont., Nev., N. Mex., Oreg., Utah, Wash., Wyo.	Western fruits, nuts, vegetables, rice; poultry products; forage crops; wheat; barley; wool and mohair; sugar beets; dry beans and peas; castor seed; new crops.

\* STATES LISTED ARE THOSE PRIMARILY SERVED BY THE PARTICULAR DIVISION, ALTHOUGH THE RESEARCH PROGRAMS OF EACH DIVISION ARE OF NATIONAL SCOPE AND INTEREST.



Growth Through Agricultural Progress

